## Module 1: Foundations of Sustainable Agri-Food Systems & Circular Economy

**Differentiated Content Lecture & Speaker Notes - Activity Worksheet**
**Red Notes**

**Systems Thinking Mapping Activity**
**Grouping: Pairs or small groups (3–4)**
**Time: 25-30 minutes**

### Materials:

- Printed worksheet with doughnut diagram
- Colored pencils or markers
- Access to prior lesson notes/slides on food systems, circularity, and systems thinking

### Objective:

To introduce systems thinking as a framework for analyzing food systems using nature's circular models. Students will identify components of systems and explore how feedback loops can be broken or repaired.

### Instructions:

1. Answer the questions below before continuing to the diagram activity. This will help you create it.
2. Place a dot on the doughnut diagram:
    - Inside the hole = social shortfall
    - Outside the ring = ecological overshoot
3. Explain your reasoning.
4. Suggest how natural circularity (e.g., composting, nutrient loops) could improve the system.
5. Reflect on how systems thinking helped you understand your food's impact.

### Your Task:

In this activity, you will apply systems thinking to explore two systems: a natural ecosystem and a school-based food system (e.g., cafeteria). For each system, identify the key components:

- Inputs
- Processes
- Outputs
- Feedback loops

Then compare how these systems close or break loops.

**Step 1: What is Systems Thinking?**
Systems thinking is a way of seeing the whole picture—how the parts of a system connect, influence one another, and change over time. It focuses on relationships rather than isolated parts, helping us understand the ripple effects of our actions. The goal is to recognize these connections so we can create lasting solutions without causing new problems. For example, your lunch is part of a larger food system involving farmers, transporters, water, soil, energy, and waste.

In your own words, how would you describe systems thinking?

In my own words, systems thinking means looking at the big picture and seeing how everything is connected. Instead of focusing only on one part, like food waste, I think about how food is grown, transported, eaten, and then turned into waste again. It helps me see the ripple effects of choices, like how composting in the cafeteria can help gardens grow.

**Step 2: Nature as a Circular System**
In nature, nothing is wasted. A forest recycles sunlight, water, and nutrients into new life.
Your cafeteria: What could be recycled instead of wasted?

- Example: food scraps → compost → soil for gardens.

Food scraps like apple cores or leftover rice could be collected for compost instead of thrown away.

One idea for making your cafeteria more circular:

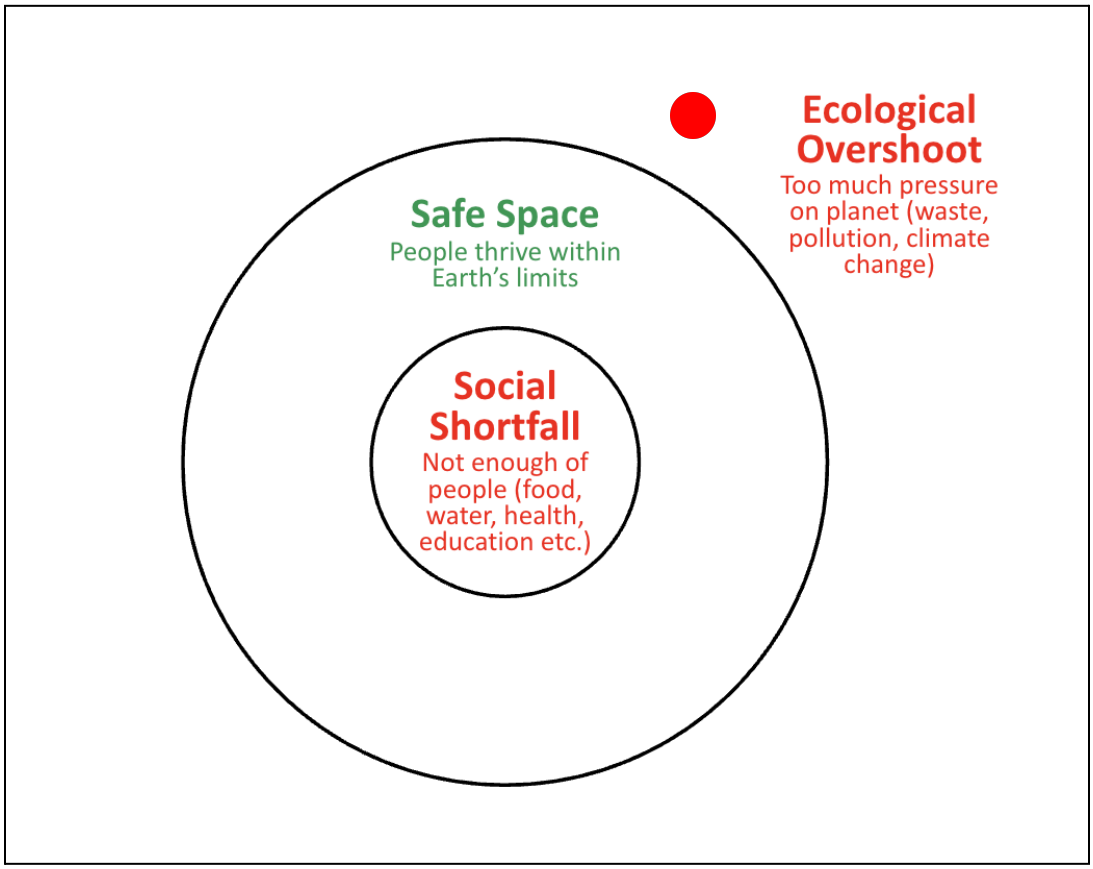
We could set up a compost bin for food scraps and use the compost in the school garden to grow herbs or vegetables for the cafeteria.

**Step 3: Doughnut Thinking - Finding the Safe Space**
Look at the doughnut diagram on your worksheet. It shows three zones:

- Hole = people don't get enough (food, nutrition, access).
- Ring = safe space (needs met, environment protected).
- Outside = too much harm to the planet (pollution, waste, overshoot).

Your task:

1. Place a dot where you think your cafeteria system belongs.
2. Write 2–3 sentences explaining why you placed it there.
3. Suggest one change that could move the dot closer to the green safe space.




**Explanation:**

I would place my cafeteria system slightly outside the 'Safe Space' ring (toward ecological overshoot). We usually have enough food (so it's not in the hole), but we waste a lot and create extra trash, which harms the environment.

The cafeteria provides food and nutrition, so there isn't a social shortfall. However, a lot of single-use plastics and food waste go to the landfill, which means our system harms the planet. That pushes the cafeteria closer to ecological overshoot than to the safe space.

**Suggest One Change:**

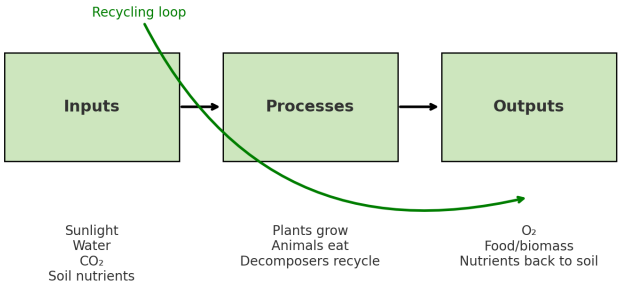
Introduce reusable trays and a composting system to cut down waste and move closer to the green safe space.

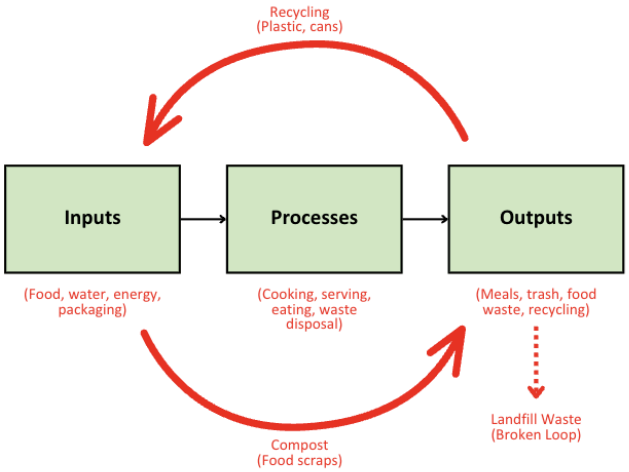
**Step 4: Side-by-Side Systems Mapping**

| **Natural System: Forest (Example)** | **School-Based System: Cafeteria** |
|---|---|
| Inputs (What goes into the forest?):<br><br>Sunlight, rainfall, nutrients in soil, atmospheric carbon dioxide, seeds / organisms | Inputs (What goes into the cafeteria?):<br><br>Packaged food, fruits and vegetables, meat, dairy, water, electricity, labor (cooks, staff), plastic utensils/containers. |
| Processes (What happens in the forest to use these inputs?):<br><br>● Photosynthesis by plants converts sunlight, water, and $CO_2$ into energy (sugars).<br>● Nutrient uptake by roots supports plant growth.<br>● Animals eat plants and one another, transferring energy through food chains.<br>● Decomposition by fungi, bacteria, and detritivores breaks down dead matter into nutrients.<br>● Respiration by plants, animals, and microbes releases $CO_2$ and cycles energy. | Processes (What happens to the food and materials?):<br><br>Food is cooked, packaged, and served to students; students eat; leftovers and packaging are thrown away. |
| Outputs (What comes out of the forest system?):<br><br>● Oxygen ($O_2$) from photosynthesis<br>● Biomass (trees, plants, animals, fungi)<br>● Organic matter (leaf litter, fallen trees, dead organisms)<br>● Nutrients returned to soil via decomposition<br>● Heat and $CO_2$ from respiration | Outputs (What comes out of the cafeteria system?): |
| Feedback Loops (How do resources cycle back? Mark ✓ if loop is closed, ✗ if open):<br><br>✓ Nutrient cycle: decomposed matter enriches soil, supporting new growth.<br>✓ Water cycle: transpiration returns water vapor to atmosphere → rainfall.<br>✓ Carbon cycle: $CO_2$ absorbed in photosynthesis, released in respiration.<br>✓ Seed dispersal: animals/insects spread seeds, ensuring regeneration.<br>✗ Occasional disruptions: deforestation, fires, or invasive species can break loops. | Outputs (What comes out of the cafeteria system?):<br><br>Student meals, full trash bins, food waste, recycling (sometimes), energy use, greenhouse gas emissions. |
| | Feedback Loops (How do resources cycle back? Mark ✓ if loop is closed, ✗ if open): |

✗ Food waste → landfill → methane (broken loop).
✗ Plastic → trash → no reuse (broken loop).
✓ Recycling bins (if used correctly, partial closed loop).
✗ Nutrients in food → not returned to soil (broken loop).

**Draw Arrows:** Step 1, Use arrows to show how inputs move through processes to become outputs, Step 2, marking any cycles that return to the start as closed loops and any losses as broken loops. A template is given below.




**Step 5: Compare Systems and Improvements**

1. What is the biggest difference between forest and cafeteria systems?

The forest naturally recycles almost everything, so its loops are mostly closed. In the cafeteria, many resources (food, plastic, energy) are wasted and don't return to the system, so most loops are broken.

2. Propose a policy or innovation that could improve the cafeteria system:

Create a composting program for food scraps and a reusable utensil program to replace plastics.

3. Given your idea, how would it strengthen or close a loop?

Composting would close the nutrient loop by turning food waste back into soil that can grow new food. Reusable utensils would reduce the broken plastic loop.

**Reflection Prompt:**
What is one lesson nature teaches us about designing better food systems?

Nature shows us that nothing should go to waste. In forests, dead leaves become soil and energy flows in cycles. If our food systems copied this, by composting or recycling nutrients, we could reduce waste and make our systems more sustainable.

**Skills You'll Use:**

- Systems thinking
- Analyzing real-world sustainability challenges
- Visual reasoning and communication
- Reflection and solution design